INTEGRATING RENEWABLE ENERGY SERVICES IN REMOTE INDIGENOUS COMMUNITIES OF AUSTRALIA: A NATIONAL STRATEGY

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ABSTRACT

The paper reports findings of a market survey of RE installations in remote Indigenous communities of Australia and the perceptions of people living in these communities in relation to RE. A lack of information, high up front costs, a shortage of trained personnel, lack of regular maintenance and distance to service centres were all identified as barriers to successful integration of RE in these communities and all contributed to negative market perceptions among Indigenous people.

The paper outlines a national strategy focused on a shift away from installation of "off the shelf" technologies and systems to integration of sustainable remote energy services in Indigenous communities throughout the remote outback of Australia.

INDIGENOUS COMMUNITIES

The number of remote Indigenous communities in Australia has grown over the last 30 years largely due to the outstation movement and increased support for healthy living environments in Indigenous communities.

In 1999 the Australian Bureau of Statistics[i] identified 1291 discrete Indigenous communities throughout Australia. In 1992 ATSIC[ii] had identified 907 communities of which 819 were in remote regions.

Table 1: Total Number and Population of Discrete Indigenous Communities

	Number		**Population**		**Average Size**	
Year	***1992***	**1999**	***1992***	**1999**	***1992***	**1999**
Total	***819***	**1291**	***73297***	**109994**	***106***	**107**

The average size of these discrete Indigenous communities in 1999 was 107 people. A total of 109 994 people (31% of Australia's Indigenous peoples) lived in discrete Indigenous communities in 1999, the remaining number lived in cities and large urban localities.

Table 2: Number of Communities of Different Sizes and Population in Each Group

Community Size	0 to 20	21 to 50	51 to 100	101 to 200	Over 200	Total
No of Communities	644	299	102	97	149	1,291
Total Population	5,682	8,889	6,765	12,779	75,879	109,994
Percentage of Population	5.2%	8.1%	6.2%	11.6%	69%	100%

Of the recorded 1291 communities, 943 had less than 50 people in them (73% of all Indigenous communities have less than 50 people). Conversely 69% of those Indigenous people living in discrete non urban communities are in communities of greater than 200 people. These figures vary widely across the States and Territory.

The small size and high levels of mobility in many of these regional communities, combined with a lack of access to specialised services, low levels of technical training and formal skills and small community budgets, make provision of services extremely challenging.

While over 85% of Australia's population reside in its major coastal centres, the remote regions of Australia are used for agriculture, mining and tourism, and are home to many of its Indigenous people. The provision of electrical energy over such vast areas is difficult and usually falls back to small individual systems for communities. Renewable energy has traditionally been seen as an economic option in such areas, however, little was known about the aspirations and attitudes of Indigenous people in this market. A market survey of renewable energy applications in remote Australia was undertaken between 1998 - 2000 by the Centre for Appropriate Technology (CAT) in Alice Springs as a commitment to the research effort of the Australian Cooperative Research Centre for Renewable Energy (ACRE) [iii].

Map showing main site visits.

A total of some 88 Indigenous communities were field surveyed. Typically the sites surveyed were small outstations consisting of between one and five houses; perhaps with a workshop and almost always with a bore water supply. The average number of inhabitants was 14 within a range from 3 to around 50. The sites were remote: the average distance to a regional centre was 280 km (70 km to nearly 1000 km).

The total installed PV systems surveyed was over 243 kW coming from nearly 3400 panels. The average number of panels per house (for PV powered houses) was 8 giving around 0.63 kWp per house. A total of 2201 batteries were examined. In terms of battery types it was found that 67% of systems used flooded cells and 33% sealed, valve-regulated cells. Nine communities surveyed had a wind component as part of the renewable energy system and two communities had a battery system with no renewables.

MARKET SURVEY FINDINGS

A major conclusion from the data collected is that renewable energy systems, used as RAPS, are not maintenance-free. Any advertising to suggest the contrary is destined to harm the RE industry's credibility. Maintenance is mainly needed for the balance of system components and includes regular servicing and storage battery replacement. Costs for such maintenance are strongly related to the distance of the system from the nearest service centre. Lack of regular maintenance support for RE systems is thought to be one of the major issues to be tackled to obtain a viable RE product in remote areas.

In general the smaller (less than 5 kW) renewable energy systems tended to be both more reliable and better received by the market than larger systems. RE powered water supply systems (mainly solar bores) fared much better in terms of reliability than RE electricity supply systems.

The penetration of RE into Indigenous communities was found to be 21%. The number of systems operational in Indigenous communities at the time of survey was 64%. As might be expected the satisfaction with the RE systems in Indigenous communities was low at 40%. Fourty three per cent of Indigenous communities complained of recent difficulties. The causes of failure identified 20% of problems attributable to batteries, and 23% to electronic problems. A significant finding was that only 2% of Indigenous people surveyed thought that energy conservation was important. Demand patterns with regards to end use technologies in remote areas were similar to urban environments. The demand for energy efficient appliances was not significant.

The high capital cost of RE systems was a significant disadvantage, with the lack of reliable operation next in importance. Indigenous communities placed stress on the need for reliability. Education and training were perceived to be vital to the success of RE systems in remote areas, however, good on-the-ground examples of successful training packages were not apparent. Existing warranties for RE systems were not found to be consistently honoured. Some method of implementing a system of warranties that would be both fair to the consumer and to the supplier was thought highly desirable. Demonstration systems were generally not thought to be the best way of transferring technology with people resenting being used as guinea pigs by having technology that was often in the process of development, transferred to them.

While the survey found that the range in market perceptions towards RE was considerable, there was, however, more opposition to RE than expected, and significantly, the consumer's attitude was often opposed to the industry view. The one point that was obvious from the study was that transport costs tended to dominate overall system economics in remote areas.

Failures in the electronic control systems and inverters tended to dominate recurrent maintenance problems while battery failures were found to be the most common final reason for system failure. Although around two thirds of systems had wet cell batteries, the failure rate for wet and sealed, valve-regulated cells were approximately equal. The observed electronic control/inverter systems tended to have high component counts, often in several discrete boxes from different original manufacturers. The great number of different systems that were observed during the field studies was found to lead to a low level of both operator and maintenance technician familiarity. For the larger systems, maintenance and problem solving had to be referred to the original manufacturer or a regional supplier. The conclusion from this plethora of electronic options is that there is a need for the renewable energy industry to produce standardised, reliable, user-friendly designs.

In relation to Indigenous communities people just want to be warm or cool, to cook and see in the dark, they want water and hot water to wash and drink, they want to communicate, play in the band and watch television. Basically they want to live with the highest level of service that can be provided and afforded. In as much as these things involve energy or electric power one could say they are wanted, however, people are generally not wanting to buy an energy system or own an electric utility. They want to buy a reliable service and obtain a benefit. Their expectations of the benefits will change over time and as development occurs. Indigenous communities generally place a higher priority on function than on the fact that a system uses renewable energy. Overloading of systems is therefore common due to high household size fluctuations and high expectation of systems once installed. To date the RE industry has tried to constrain demand to match

the economics of the technology. Responsive flexible systems will be required in the future. Currently the risk of overload is met through installation of diesel backup and system oversizing.

As an industry and research community we need to do better than this if we are to convince the people in Australia's Indigenous communities that RE is viable and reliable.

CHALLENGES TO INTEGRATION OF RE TECHNOLOGIES IN INDIGENOUS COMMUNITIES

Although many smaller communities have adopted RE systems there is a perception that commercial systems, while offering the potential for cheap power, are not sufficiently reliable in the physical and social environments which characterise remote Indigenous communities.

- Technologically complex elements of systems are prone to breakdown, with parts often being expensive to replace, and difficult to obtain in remote areas. These problems are compounded by a relative lack of standardisation across commercially available systems;

- Many systems do not generate sufficient power to cope with peaks in demand and, without other support or advice, communities either experience frequent power outages or overly rely on diesel back-up systems;

- In the absence of technical advice communities may purchase renewable energy systems for their total power needs when these might be better met by a mix of smaller supply systems tailored to different power uses, including greater use of small-scale direct-current (DC) supplies and energy efficient appliances.

These issues have the potential to substantially limit the expanded use of RE, particularly by larger communities. In addition, systems that do not perform as expected contribute to poor economic, health and social outcomes for these communities. The survey identified several initiatives that would lead to better integration of RE technologies with indigenous communities:

<u>High capital cost of RE:</u>
Innovative schemes are needed to finance capital costs. The Australian Greenhouse Office and the Department of Industry, Science and Resources are currently progressing this challenge with a series of industry and consumer initiatives[iv] .

<u>Increase reliability of RE in remote locations:</u>
There is a need for product innovation focussed on reducing component count, developing "standard" systems, increased use of third party, accredited testing laboratories and improved quality control during manufacture. Feedback to industry is also needed to highlight product deficiencies. The development of standard systems should lead to increased production volumes and hence decreased production costs.

<u>Provide effective trained personnel to maintain and service RE systems:</u>
There is a need for improved education programs and improved accreditation of installers for remote areas.

<u>Improve back up for RE systems in remote areas (especially Indigenous communities):</u>
There is a need to establish a dedicated service for Indigenous communities. Flow on could be expected to other sectors.

<u>Manage information regarding RE capabilities and availability:</u>

There is a need to establish a national clearinghouse and database. Particular emphasis should be given to distributing information on reliability.

Address demand management problems:
There is a need for consumer education on demand management, development and manufacture of high efficiency end use devices, electronic control solutions for managing demand and looking at demand management and household energy use as a whole.

Overcome the mismatch in perceptions between the industry and the market: There is a need to continue objective market research and to keep a close watch on consumer attitudes, in particular to emphasise reliable first hand information.

A STRATEGY TO INTEGRATE SUSTAINABLE ENERGY SERVICES IN REMOTE AUSTRALIAN INDIGENOUS COMMUNITIES.

These challenges to commercialisation and integration have been reviewed through workshops of industry, Indigenous groups and funding agencies. Australia currently has before it a national strategy to integrate sustainable energy services in remote Indigenous communities.

The strategy combines linked programs of research and product testing, energy-usage analysis, industry and community sector capacity-building strategies and capital for development of new energy services.

The strategy is an integrated package which:

- addresses deficiencies in existing renewable energy (RE) systems in small remote indigenous communities;
- undertakes research and testing to establish best practice in installed technology and associated support for RE systems in small community contexts;
- fosters the promotion of best practice among small scale RE suppliers through cooperative development of an accreditation system for suppliers to small remote communities;
- accelerates capital funding for renewable energy in remote communities;
- builds local and regional capacities for self management of renewable energy systems;
- assists the Australian renewable energy industry to position itself to gain greater access to overseas markets for small community/village energy supplies.

The strategy seeks to develop RE industry capacity to deliver improved energy services to small remote Indigenous communities. The key shift in industry practice is away from installation of “off-the-shelf systems” and toward a more holistic approach to remote energy services. The proposal seeks to influence industry through a combination of targeted research and testing, improved data on community level energy use and system performance, and new approaches to community level purchasing which will encourage industry to adopt a stronger focus on community consultation and education, a less “product-driven” approach to system design and choice, and greater attention to recurrent management and support of installed systems. It includes industry awareness forums on remote community service delivery issues.

The primary benefits of this approach are twofold. The strategy should improve the service quality and price delivered by RE for remote Indigenous communities. The expanded capability of RE system suppliers which is developed through pilots and market performance in Indigenous communities, is expected to also promote greater access to international small village energy supply markets for Australian RE suppliers.

STRATEGY COMPONENTS

The strategy proposes three linked components.

1 Community Education and Energy Information Services

Greater community awareness of energy issues and supply technologies is essential to achieving improved outcomes in this area. There are three areas in which information is lacking:

- Policy Formulation: Broad based information on Indigenous community energy use patterns is minimal, making the establishment of broad-based strategies difficult. There is a need to begin collecting and collating this information immediately.

- Resource Agencies: Where agencies fund the provision of energy services to small communities there are often not support services available to provide independent technical information and advice to communities exploring energy options.

- Community: Once in place, the effectiveness and reliability of energy systems is improved by users having an understanding of their energy demand along with a set of demand side strategies that can be used to match demand with supply. There is a need for improved community education of energy use and demand side management practices.

Key elements:

- develop a reusable and adaptable audit kit to enable small-community energy audits;

- undertake piloting and demonstration of audits in several community projects to link audits to demand management and system design processes;

- develop, test and implement community energy education strategies;

- expand the National Technology Transfer Clearinghouse to include an advisory and outreach role for small communities undertaking RE system procurement;

- assemble a database drawing on energy audits which is accessible to communities and industry to support planning and performance monitoring.

2 Improved Supply Options

The diversity of circumstances under which Indigenous communities live means a national energy services program must be capable of providing a range of supply options that suit the unique requirements of individual communities. Suppliers should also be made aware of these unique requirements, which may differ from those of non-Indigenous customers.

The initial focus of this program targets the provision of energy services to outstations and small communities that are not serviced by State/Territory agencies.

Larger communities, with their heavy reliance on diesel fuel could also benefit considerably from the use of RE. This does not necessarily translate to the use of large RE systems in a central community power station, but involves research and implementation of systems in any areas where RE can effectively meet energy needs and reduce overall diesel fuel use.

The strategy will examine the potential for DC supply of essential services in communities with AC being used for discretionary power use. This will involve sourcing and testing of products and appliances that deliver the benefits of energy services to members of the household. The strategy helps to eliminate factors associated with complex electronic systems which are a frequent source of breakdown in current alternating current RE systems.

The RE market in Indigenous communities is potentially very large. Over the past twenty years, industry has entered this market, installing numerous RE technologies with varying degrees of success (and hence varying outcomes for Indigenous communities).

The strategy will help create a greater awareness within the RE industry of the shortcomings of many current commercial systems and levels of service delivery in relation to the particular circumstances of Indigenous communities.

Further, the long-term reliability of energy services is necessary to provide sustainable quality outcomes for Indigenous communities. A service provider accreditation scheme will provide assurance of installation and service quality for Indigenous communities.

Key elements:

- expand currently funded RAPS demonstration projects to look at "small-community" issues;
- pilot a build/own/operate (BOO) procurement strategy in small remote communities;
- lab and field test hybrid AC/DC systems (supply reticulation and commercial appliances);
- develop and test a business case for procurement of DC equipment and appliances;
- develop an accreditation system for suppliers to remote communities, linked to accreditation developments in the mainstream industry;
- sponsor industry awareness forums.

3 Capital Grants and Capacity Building in Service Delivery

The success of the overall strategy depends upon the implementation of a delivery mechanism which offers ongoing support to communities and is linked closely to an informed consideration of community energy requirements and service options.

Up to 240 small Indigenous communities will benefit from capital grants. Initial grants will be to communities for RE systems which have proven reliable in similar communities. This strategy provides opportunities to test and implement complementary strategies in procurement and community education.

A number of conditions are attached to the capital grants ensuring quality installations and maintenance of the systems as well as a community commitment to its success.

The capacity building component establishes 3 mobile service delivery teams whose primary focus is establishing best practice in providing community support and skill transfer. Regular maintenance of RE systems is necessary to ensure long term system reliability and community satisfaction. The delivery mechanism should be capable of providing Indigenous communities with the capacity for ongoing maintenance and repair. The RE service delivery teams would also provide training in system repairs and maintenance and offer communities information and education programs on issues relating to energy use and other essential services including water supply and information and communication technologies.

This team will function as part of an integrated technical support agency responsible for servicing community and/or outstation infrastructure needs (including water, energy, communication and housing).

Key elements:

- capital grants to establish new RE systems through matched funding, using design and delivery techniques refined through linked components in the strategy;

- establishment and initial operations of 3 mobile RE service teams targeting small remote communities.

THE DISTRIBUTED DEVELOPMENT PARADIGM

Although this strategy is primarily aimed at providing reliable energy services to Indigenous communities in order to improve quality of life, the project also has significant potential to boost Australian exports of goods and services in an important sector of an emerging industry.

Several developments in the past 5 years point towards a significant market emerging in village electrification projects[v]. Large icon energy projects are coming under increasing pressure because of environmental constraints and governance issues. Furthermore, delivering development assistance to regional areas mitigates some of the social dislocation associated with urban drift in developing countries. These issues have been recognised by the World Bank[vi] and other development agencies, and as a consequence, provision of remote energy services will become increasingly important in regional development if people are to benefit from micro enterprises and the new information economy.

Because RAPS and distributed small-scale generation is an emerging sector within a growing market, the competitive niche is still relatively unoccupied. Indigenous communities and Australian companies should be well placed to be the beneficiaries of the natural advantage conferred by Australia's demography and remoteness.

Australia is well positioned to take advantage of a full service delivery paradigm within isolated communities because of our potential to ensure service delivery in these communities rather than simply providing technology implementation.

This strategy addresses issues associated with delivering energy services to remote communities in one of the most challenging environments in the world.

A major focus of the proposal is on community education and participation in delivery and management of systems. The proposal includes relatively significant resources for education and community participation strategies. The extent of these resources reflects the scope of the industry shift that is needed to effectively engage in the development paradigm which is relevant for essential service delivery to many Australian Indigenous communities and small isolated villages overseas.

CONCLUSION

There are three key principles for the successful integration of sustainable energy services in Indigenous communities of Australia.

- people will use an energy service that allows them to very simply and cheaply derive a benefit.
- the provider of the energy service and the consequent benefit must be reliable above all else.
- the service must be able to develop over time as communities develop

There is a clear need for a paradigm shift away from an emphasis on the development of RE technology to the provision of holistic energy services that meet the needs of people. The strategy outlined in this paper provides the opportunity for Australia to better understand the shift and develop a service industry built on renewable energy sources.

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[i] Australian Bureau of Statistics, "*Housing and Infrastructure in Aboriginal and Torres Strait Islander Communities, Australia, 1999."* ABS Catalogue No. 4710.0, Australian Bureau of Statistics, Canberra, Australia, 2000.

[ii] Aboriginal and Torres Strait Islander Commission*,* "*1992 National Housing and Community Infrastructure Needs Survey – Final Report Stage 1."* Australian Construction Services, Brisbane, Australia, November 1993.

[iii] Lloyd B, Lowe D, Wilson L, "*Renewable Energy in Remote Australian Communities (A Market Survey)",* Australian CRC for Renewable Energy Ltd, Perth, Australia 2000. The report is in three parts, Executive Summary, Final Report and Case Studies. The Australian CRC for Renewable Energy is based at Murdoch University, Perth, Western Australia. (http://acre.murdoch.edu.au) The authors worked for CAT.

[iv] *"*The Commonwealth Government recognises that renewable energy will be an important feature of Australia's response to the Kyoto Protocol and Australia leads the world in its support for renewable energy as a way of reducing greenhouse gas emissions. In this regard, the Government has instituted a range of targeted programmes and initiatives costing around $380m over four years to promote the development and use of renewable energy. These include:

- requirement that 9500 GWh (or around 2%) of Australia's energy supply be sourced from renewable energy by 2010;
- Remote Renewable Power Generation Programme;
- Photovoltaic Rebate Programme;
- Renewable Energy Showcase Programme;
- Renewable Energy Commercialisation Programme;
- Renewable Energy Equity Fund; and
- Renewable Energy Action Agenda.

Eligible renewable energy initiatives will also be able to seek support under the four-year, $400m Greenhouse Gas Abatement Programme*."*

[v] Charters, W.W.S, "*Developing markets for renewable energy technologies*" Proceedings of World Renewable Energy Conference, Perth, Australia 1999.

[vi] The World Bank, "*Rural Energy and Development: Improving Energy Supplies for Two Billion People*", Development in Practice Series, The World Bank, 1996.